ACM RESIDENTIAL MANUAL APPENDIX RF-2005

Appendix RF – HVAC Sizing

RF.1 Purpose and Scope

ACM RF-2005 is a procedure for calculating the cooling load in low-rise residential buildings (Section RF2) and for determining the maximum cooling capacity for credit in ACM calculations (Section RF3). Section RF4 has a procedure for determining compliance for oversized equipment by showing that the peak power is equal to or less than equipment that minimally meet the requirements of this section.

RF.2 Procedure for Calculating Design Cooling Capacity

The following rules apply when calculating the design cooling:

RF.2.1 Methodology

The methodologies, computer programs, inputs, and assumptions approved by the commission shall be used.

RF.2.2 Cooling Loads

Except as specified in this section, calculations will be done in accordance with the method described in Chapter 28, Residential Cooling and Heating Load Calculations, 2001 ASHRAE Fundamentals Handbook. Interpolation shall be used with tables in Chapter 28. The methods in Chapter 29 may not be used under this procedure.

RF.2.3 Indoor Design Conditions

The indoor cooling design temperature shall be 75°F. An indoor design temperature swing of 3°F shall be used.

RF.2.4 Outdoor Design Conditions

Outdoor design conditions shall be selected from the 1.0 Percent Cooling Dry Bulb and Mean Coincident Wet Bulb values in Joint Appendix II REF.

RF.2.5 Block Loads

The design cooling capacity used for calculating the maximum allowable cooling capacity is based on the block (peak) load either for

1. The whole building; or
2. For each zone within a building that is served by its own cooling system; or
3. For each dwelling unit within a building that is served by its own cooling system.

Room-by-room loads are not allowed for calculating the design cooling capacity.

RF.2.6 Table Selection

Tables 2 (cooling load temperature differences) and 4 (glass load factors) shall be used for:

1. Buildings with more than one dwelling unit using whole building block loads; or
2. Buildings or zones with either east or west exposed walls but not both east and west exposed walls.

Otherwise, Tables 1 (cooling load temperature differences) and 3 (glass load factors) shall be used.

Note: The table numbers refer to the ASHRAE Fundamentals 2001.

RF.2.7 U-factors

U-factors for all opaque surfaces and fenestration products shall be consistent with the methods described in Section 4.2 and Section 4.3 of the Residential ACM Manual. The effects of radiant barriers or cool roofs shall be included if these features are in the proposed building.

RF.2.8 Solar Heat Gain Coefficients

Solar heat gain coefficients (SHGC) shall be equal to the $SHGC_{closed}$ values described in Section 4.3.4 of the Residential ACM Manual.

RF.2.9 Glass Load Factors

Glass load factors (GLFs) shall be calculated using the equation in the footnotes of Tables 3 and 4 in Chapter 28 using the columns for "Regular Double Glass" and the rows for "Draperies, venetian blinds, etc". The table values used in the equation shall be $U_t = 0.55$ and $SC_t = 0.45$. The shading coefficient for the alternate value shall be SC_a = SHGC x 0.87 where the SHGC value is described above. The GLF values shall also be adjusted for latitude as described in the footnotes.

Note: The table numbers refer to the ASHRAE Fundamentals 2001.

RF.2.10 Infiltration

The air flow (CFM) due to infiltration and mechanical ventilation shall be calculated with the effective leakage area method as documented in Section 4.5.1 of the Residential ACM Manual using the outdoor design temperature minus the indoor design temperature as the temperature difference and a 7.5 mph wind speed.

RF.2.11 Internal Gain

Occupancy shall be assumed to be two persons for the first bedroom and one person for each additional bedroom per dwelling unit. Each person shall be assigned a sensible heat gain of 230 Btu/hr. Appliance loads shall be 1200 Btu/hr for multifamily buildings with common floors and ceilings. Otherwise the appliance load is 1600 Btu/hr.

RF.2.12 Cooling Duct Efficiency

The cooling duct efficiency shall be calculated using the seasonal approach as documented in ACM Section 4.8.8.

RF.2.13 Latent Factor.

The latent factor shall be 1.0.

RF.2.14 Total Cooling Load

The total cooling load is calculated in accordance with Table 9 of Chapter 28 of the ASHRAE Handbook, Fundamentals Volume, 2001, using the values specified in this section.

RF.2.15 Design Cooling Load

The design cooling load is equal to the total cooling load divided by the cooling duct efficiency.

RF.2.16 Design Cooling Capacity

The design cooling capacity calculation adjusts the sensible design cooling load to estimate the rated cooling capacity needed as follows:

Equation RF-1

$$\text{Design Cooling Capacity (Btu/hr)} = \text{Design Cooling Load (Btu/hr)} \times (0.8192 + 0.0038 \times \text{Outdoor Cooling Design Temperature (°}F\text{)})$$

RF.3 Procedure for Calculating Maximum Cooling Capacity for ACM Credit

The following rules apply when calculating the maximum cooling capacity for ACM credit:

RF.3.1 Design Cooling Capacity

The design cooling capacity shall be calculated in accordance with the procedure described in RF2.

RF.3.2 Maximum Cooling Capacity for ACM Credit

For buildings with a single cooling system or for buildings where the design cooling capacity has been calculated separately for each cooling system, the maximum cooling capacity for ACM credit for each cooling system shall be:

Table RF-1 – Maximum Cooling Capacity for ACM Credit

Design Cooling Capacity (Btu/hr)	Maximum Cooling Capacity for ACM Credit (Btu/hr)
< 48000	Design Cooling Capacity + 6000
48000 - 60000	Design Cooling Capacity + 12000
>60000	Design Cooling Capacity + 30000

For buildings with more than one cooling system where the design cooling capacity has been calculated for the entire building, the maximum cooling capacity for ACM credit for the entire building shall be:

Equation RF-2

$$\text{Maximum Cooling Capacity for ACM Credit (Btu/hr)} = \text{Design Cooling Capacity (Btu/hr)} + (6000\ \text{(Btu/hr)} \times \text{Number of Cooling Systems})$$

RF.3.3 Multiple Orientations

For buildings demonstrating compliance using the multiple orientation alternative of Section 151(c), the maximum cooling capacity for ACM credit is the highest, considering north, northeast, east, southeast, south, southwest, west and northwest orientations. For buildings with more than one cooling system, the orientation used for determining the maximum cooling capacity for ACM credit shall be permitted to be different for each zone.

RF.4 Procedure for Determining Electrical Input Exception for Maximum Cooling Capacity for ACM Credit

The installed cooling capacity shall be permitted to exceed the maximum cooling capacity for ACM credit if the electrical input of the oversized cooling system is less than or equal to the electrical input of a standard cooling system using the following rules:

RF.4.1 Design Cooling Capacity

The design cooling capacity shall be calculated in accordance with the procedure described in RF2.

RF.4.2 Standard Total Electrical Input

The standard electrical input is calculated as follows:

Equation RF-3

$$\text{Standard Total Electrical Input (W)} = 0.1170.1048\ (\text{W/Btu/hr}) \times \text{Design Cooling Capacity (Btu/hr)}$$

RF.4.3 Proposed Electrical Input

The proposed electrical input (W) for the installed cooling system is calculated as follows:

Equation RF-4

$$\text{Proposed Compressor Electrical Input (W)} = \text{Electrical Input (W)} - (.0122 * \text{Design Cooling Capacity (Btu/hr)})$$

Where "Electrical Input" is as published in the Directories of Certified Appliances maintained by the California Energy Commission in accordance with the requirements of the Appliance Standards.

The proposed electrical input (W) for the installed cooling system is published as the "Electrical Input" in the Directories of Certified Appliances maintained by the California Energy Commission in accordance with the requirements of the Appliance Standards.

RF.4.4 Proposed Fan Power

The proposed fan power (W) of the installed cooling system is equal to either:

1. 0.017 (W/Btu/hr) x Design Cooling Capacity (Btu/hr); or
2. The measured fan power (W) where the measured fan power is determined using the procedure described in ACM RE-2005 of the *Residential ACM Manual*.

RF.4.5 Proposed Total Electrical Input

The proposed electrical input is equal to:

Equation RF-5

$$\text{Proposed Total Electrical Input (W)} = \text{Proposed Electrical Input (W)} + \text{Proposed Fan Power (W)}$$

For buildings with more than one cooling system, the proposed total electrical power shall be the sum of the values for each system. If the proposed total electrical input is less than or equal to the standard total electrical input, then the installed cooling capacity may exceed the allowable cooling capacity for ACM credit.